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Gulf of Maine-Georges Bank Windowpane Flounder

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1.0 Background

No stock structure information is available. Therefore, a provisional arrangement has been adopted that recognizes two stock areas based on apparent differences in growth, sexual maturity, and abundance trends between windowpane flounder from Georges Bank and Southern New England. The proportion of total landings contributed by the Gulf of Maine is low, so these windowpane flounder landings are combined with those from Georges Bank and the two regions are assessed as the Gulf of Maine-Georges Bank (GOM-GB) stock. The GOM-GB stock boundary includes statistical areas 511-525, 542-543, 551-552, and 561-562.

The GOM-GB windowpane flounder stock has never been formally assessed as part of the SAW/SARC process However, index-based assessments have been conducted at previous Groundfish Assessment Review Meetings (GARM), most recently in September 2005, at which time the stock was deemed not overfished and overfishing was not occurring (NEFSC 2005). Two of the research recommendations from the 2005 GARM, discard estimation and the inclusion of inshore survey strata in the calculation of survey indices are addressed herein. An age-based assessment for this stock is not possible because there is no age composition data available from either the research surveys or fishery samples.

2.0 The Fishery

Landings

Commercial landings data are available for 1975-2006 (Table P1, Figure P1). During 1964 through May of 1994, commercial landings and additional fishery-related data were collected and entered into a Federal database by NMFS port agents. Since then, suchdata have been electronically reported by fish dealers and fishing location (statistical area) and fishing effort data related to landings are only available in the Vessel Trip Report database. As a result, the landings data and biological sampling data were allocated to statistical reporting areas based on Vessel Trip Report data using the method described in Wigley et al. (2007a).

Landings of GOM-GB windowpane flounder were highest (1,212 - 2,862 mt) when a directed fishery existed during 1985-1993 (Figure P1, Table P1). After 1993, landings declined rapidly and totaled 50 mt or less during 2001-2006.

Discards

Initial estimates of windowpane flounder discards, during 1975-2006, are provided for the large mesh bottom trawl fleet (codend mesh size ≥ 5.5 inches), small mesh groundfish fleet (codend mesh size < 5.5 inches), and the sea scallop fleets (dredge and bottom trawl combined, “limited permits” only) in Table A.P1 of the Appendix. Discards (mt) for 1989-2006 were estimated using fisheries observer data and the combined ratio method described in Wigley et al. (2007b). Due to the low numbers of trips sampled by quarter, the small mesh bottom trawl and scallop dredge/trawl fleets were binned by half year to derive discard estimates (Table A.P2). For both fleets, imputations were necessary during years where fewer than two trips were available. There were no observed trips for the scallop fleets during 1989 and 1990 and only one trip in 1991. As a result, scallop dredge

discards for 1989-1991 were estimated using the hindcast method described below. Discards from the large mesh bottom trawl fleet were estimated by quarter and cells with fewer than two trips were imputed using annual values. Due to a lack of fisheries observer data prior to 1989 for the trawl fleets and prior to 1992 for the scallop fleet, discard estimates were hindcast back to 1975 based on the following equation:

(1) $$\hat{D}_{t,h} = \bar{r}_{c,1989-1991,h} * K_{t,h}$$

where:

$\hat{D}_{t,h}$ is the annual discarded pounds of windowpane flounder for fleet *h* in year *t*

$\bar{r}_{c,1989-1991,h}$ is an average combined D/K ratio (discarded pounds of windowpane flounder / total pounds of all species kept) for the fleet *h* during either 1989-1991 (for the trawl fleets) or 1992-1998 (for the scallop fleet)

$K_{t,h}$ is the total pounds of all species kept (landed) for fleet *h* in year *t*

Discards are primarily from the large mesh bottom trawl fleet (considered as the small mesh fleet prior to 1982 when the minimum codend mesh size was less than 5.5 inches), but the scallop dredge fleet also contributed a substantial proportion of the total discards during 1977-1981 and 1987-1993 (Table P1). During 1975-1988, total discards ranged between 253 and 898 mt. During the directed fishery period, 1985-1993, discards averaged 41 % of the landings (Figure P1). During 2001-2004 discards ranged between 153 mt and 354 mt then more than tripled between 2004 (288 mt) and 2005 (806 mt) concurrent with the establishment of a windowpane flounder trip limit of 1,000 lbs (100 lbs per day) when fishing during a "B day at sea". Discards totaled 641 mt in 2006.

Catches

For the period 1975-2006, catches of windowpane flounder were highest during 1985-1991 and ranged between 2,013 mt and 3,645 mt (Table P1, Figure P1). Thereafter, catches declined to a time series low of 105 mt in 1999 and then increased to 955 mt in 2005. Since 2000, most of the catch has been comprised of discards.

3.0 Research Survey Data

Relative abundance (stratified mean numbers per tow) and biomass (stratified mean kg per tow) indices for GOM-GB windowpane flounder were computed using data from NEFSC autumn bottom trawl surveys conducted during 1975-2006 (Table P2, Figure P2). Indices from previous assessments were computed with data solely from an offshore strata set (13-30 and 37-40) and were not standardized for changes in trawl doors, vessels, and gear. However, the inshore strata comprise a substantial portion of the total windowpane flounder habitat. Therefore, the revised survey indices include catches from inshore strata 58-61 and 65-66, along with offshore strata 13-30 and 37-40. The revised survey indices were also standardized for changes in trawl doors (numbers = 1.54 and weight = 1.67), gear (numbers = 1.67 and weight = 1.37), and vessels (numbers = 0.82 and weight = 0.80). For the fall survey time series used in the assessment, door conversion coefficients (Byrne and Forrester 1991a) were applied to the 1975-1984 catches and vessel conversion coefficients (Byrne and Forrester 1991b) were applied

when the R/V *Delaware II* was utilized instead of the R/V *Albatross IV*. The latter occurred both within and between surveys on an irregular basis.

Annual relative abundance and biomass indices from the NEFSC fall surveys are highly variable for this thin-bodied flatfish. Relative abundance was near or below the 1975-2006 median (4.8 fish per tow) during 1986-1994 and was near the median abundance level during most years between 1997 and 2003 (Figure P2, Table P2). Relative abundance increased thereafter, and in 2007, reached the second highest level since 1984. The high abundance and low biomass levels observed during 2004-2007 are attributable to the catches of large numbers of young-of-the-year fish at multiple stations.

Relative abundance indices from the NEFSC spring surveys (1975-2007), the Canadian spring (February) surveys (Georges Bank strata 5Z1-5Z4), as well as the Massachusetts (spring and fall, strata 25-36) and Maine/ New Hampshire (spring and fall, strata 1-3 in regions 1-5) bottom trawl surveys are also presented in the Appendix (Figure A.P1). The NEFSC spring surveys appear to have lower catchabilities than the NEFSC fall surveys. Indices from the Canadian, MA, and NH/ME surveys do not encompass the entire stock area and consist of shorter time series than the two NEFSC survey series. Therefore, the NEFSC fall survey time series is considered the best indicator of stock relative abundance and biomass.

4.0 Assessment Results

Annual catches and NEFSC fall survey relative biomass indices were used as input data to the AIM (An Index-based Model, version 2.0) software provided in version 3.0 of the NOAA Fisheries Toolbox (http://nft.nefsc.noaa.gov/). Computations conducted within the AIM software package and an explanation of the model parameters are provided in the Final Report of the Working Group on Re-evaluation of Biological Reference Points for New England groundfish (Anon 2002).

Trends in annual catches and NEFSC fall survey relative biomass indices, data inputs to the AIM model, and the model results for trends in relative exploitation rates (relative F) and stock replacement ratios are presented in Figure P3. Annual relative exploitation rates (relative F), computed as the annual catch in year *t* divided by fall survey relative biomass index in year *t*, increased during 1977-1991 then decreased through 2002. Thereafter, relative exploitation rates increased to a low level in 2005 and remained constant in 2006. Replacement ratios increased between 1991 and 1998 and were above or near 1.0 during 1995-2001, then declined to a level slightly below 1.0 through 2006 (Figure P3). The model correlation between relative exploitation rates and stock replacement ratios was marginally significant ($p = 0.101$). The model results suggest that the stock can replace itself at a relative F value of 0.616 (the relative F value where the log of the replacement ratio is equal to 0, Figure P4).

5.0 Biological Reference Points

Biological reference points for GOM-GB windowpane flounder were derived, as survey-based proxies of relative biomass indices and relative exploitation rates, from the results of an AIM model run (F_{MSY} proxy) and based on trends in the NEFSC fall survey relative biomass indices relative to catches.

Based on the AIM model results, the GOB-GB windowpane stock can replace itself at a relative F of 0.616. Thus, this value can serve as an F_{MSY} proxy for the stock. Based on an examination of the trends in catch and fall survey relative abundance indices during a period when catches were most precisely estimated (1989-2006), the stock appeared to be able to sustain the levels of catch that occurred during 1995-2001 (Figure P5) because replacement ratios were near or above 1.0 during this period (Figure P3). During 1995-2001, the median catch was 670 mt and can be considered as an MSY proxy. Division of the MSY proxy of 700 mt by the estimated F_{MSY} proxy from the AIM model (= 0.616) results in a survey-based B_{MSY} proxy of 1.14 kg per tow for the GOM-GB windowpane flounder stock. Alternatively, the 75th percentile of relative biomass indices from the fall survey, during 1975-2006, is 0.94 kg per tow. This B_{MSY} proxy estimate multiplied by the F_{MSY} proxy from the AIM model (= 0.616) results in a long-term potential yield of approximately 600 mt.

6.0 Literature Cited

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Wigley S.E., P.J. Rago, K.A. Sosebee, and D.L. Palka. 2007b. The analytic component to the Standardized Bycatch Reporting Methodology Omnibus Amendment: sampling design end estimation of precision and accuracy (2nd edition). U.S. Dep. Commer., *Northeast Fish. Sci. Cent. Ref. Doc*. 07-09; 156 p.

Table P1. Landings, discards, and catches (mt) of GOM-GB windowpane flounder during 1975-2006. Landings and discards include data from statistical areas 511-525, 542-543, 551-552, and 561-562. Discards estimates include the large mesh (codend mesh size ≥ 5.5 inches) bottom trawl fleet, small mesh groundfish fleet (codend mesh size < 5.5 inches) and the sea scallop dredge fleet.

Year	Landings[1] (mt)	Discards (mt)				Catch (mt)
		Large mesh	Small mesh	Scallop dredge	Total	
1975	1,300		201	52	253	1,553
1976	1,516		213	70	283	1,799
1977	1,099		267	173	441	1,539
1978	923		292	173	465	1,388
1979	856		305	222	527	1,383
1980	408		344	246	591	999
1981	413		329	317	646	1,059
1982	411	368	206	243	816	1,227
1983	460	628	88	182	898	1,358
1984	743	642	49	124	815	1,558
1985	2,141	545	40	106	691	2,833
1986	1,842	447	35	141	623	2,465
1987	1,396	427	20	170	617	2,013
1988	1,377	413	23	269	705	2,082
1989	1,577	188	2	293	483	2,060
1990	1,078	600	60	382	1,042	2,120
1991	2,862	463	1	319	783	3,645
1992	1,519	137	0	190	454	1,974
1993	1,212	249	6	110	497	1,709
1994	339	118	158	66	458	796
1995	668	740	24	35	889	1,557
1996	773	346	0.4	63	452	1,226
1997	416	828	27	276	996	1,412
1998	398	192	0	80	363	761
1999	49	34	1	20	305	354
2000	147	124	57	21	202	349
2001	43	167	0.3	23	190	233
2002	13	126	6	21	153	166
2003	16	342	2	11	354	371
2004	26	268	13	7	288	315
2005	50	627	262	17	906	955
2006	46	530	34	76	641	687

[1] Since May of 2004, landings have been self-reported by dealers and were allocated to statistical area based on Vessel Trip Report data.

Table P2. Stratified mean catch per tow, in kg and numbers, for GOM-GB windowpane flounder caught during NEFSC fall research bottom trawl surveys, 1975-2007. Indices include offshore strata 13-30, 37-40 and inshore strata 58-61, 65-66 and standardization coefficients were applied for trawl door changes (numbers = 1.54 and weight = 1.67), gear changes (numbers = 1.67 and weight = 1.37), and vessels (numbers = 0.82 and weight = 0.80).

Year	Mean kg per tow	Mean number per tow
1975	0.63	9.10
1976	1.91	8.73
1977	2.03	8.99
1978	1.51	10.16
1979	0.96	4.12
1980	0.90	2.80
1981	1.02	3.86
1982	0.82	3.43
1983	0.94	3.27
1984	3.31	18.41
1985	0.83	10.86
1986	1.14	5.15
1987	0.63	3.39
1988	0.71	4.73
1989	0.32	1.41
1990	0.93	5.23
1991	0.19	1.18
1992	0.43	2.12
1993	0.46	4.24
1994	0.26	1.43
1995	0.79	7.40
1996	0.51	3.14
1997	0.42	4.87
1998	1.59	12.46
1999	0.76	4.29
2000	0.71	3.83
2001	0.89	9.82
2002	0.86	5.45
2003	0.74	4.62
2004	0.67	7.35
2005	0.68	9.07
2006	0.66	5.94
2007	0.24	15.59

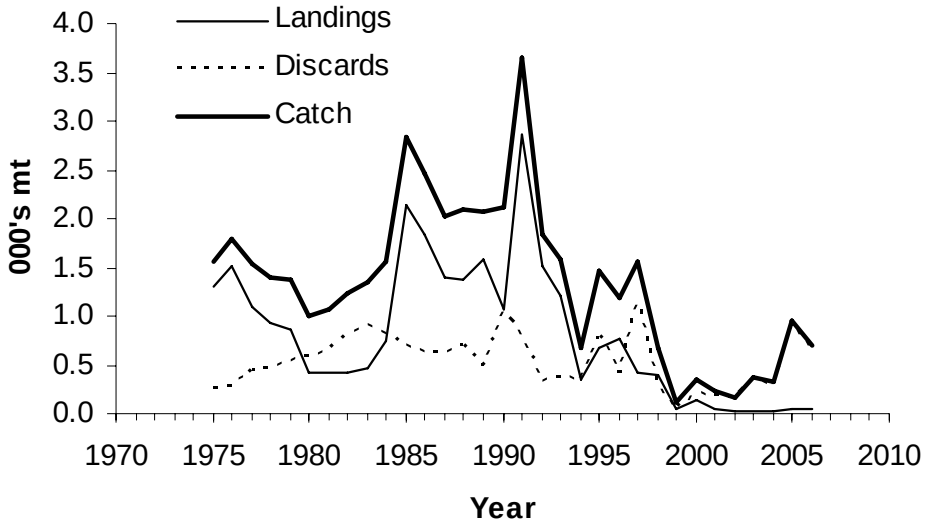

Figure P1. Commercial landings, discards and catches of Gulf of Maine-Georges Bank windowpane flounder during 1975-2006.

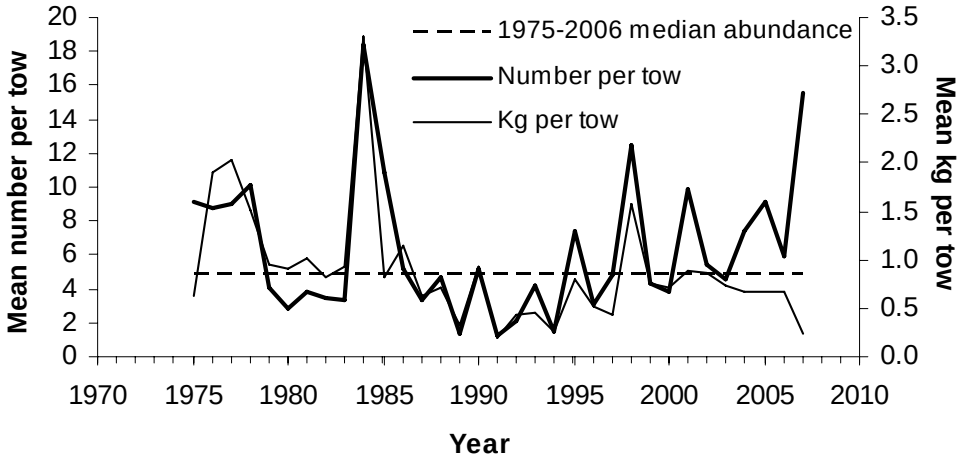

Figure P2. Relative abundance (stratified mean number per tow) and biomass indices (stratified mean kg per tow) for GOM-GB windowpane flounder caught during NEFSC autumn bottom trawl surveys conducted during1975-2007.

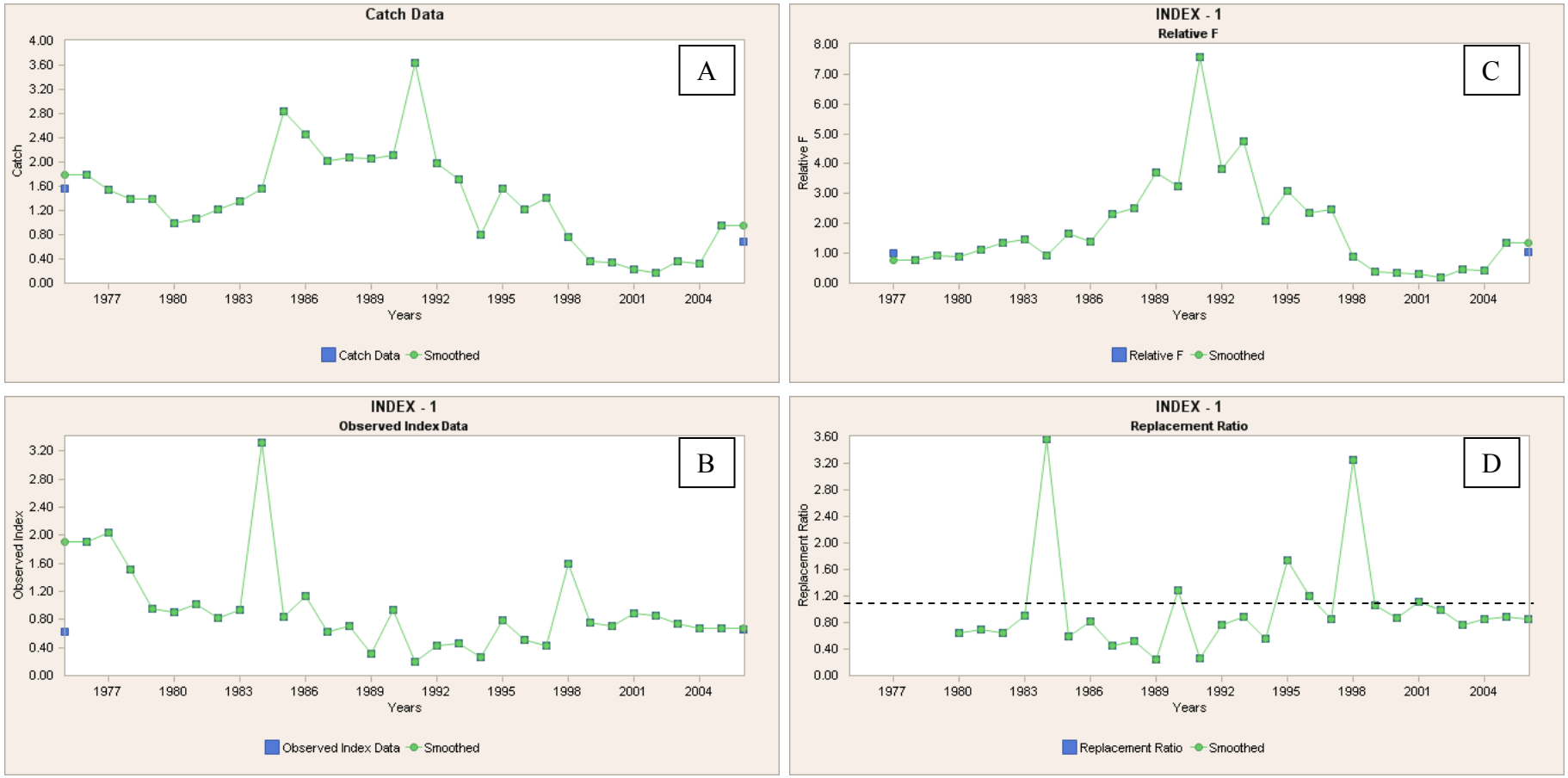

Figure P3. Trends in (A) GOM-GB windowpane flounder catches (000's mt), (B) NEFSC fall survey relative biomass indices (stratified mean kg per tow), (C) relative exploitation rates (catch/fall survey biomass index), and (D) stock replacement ratios for GOM-GB windowpane flounder.

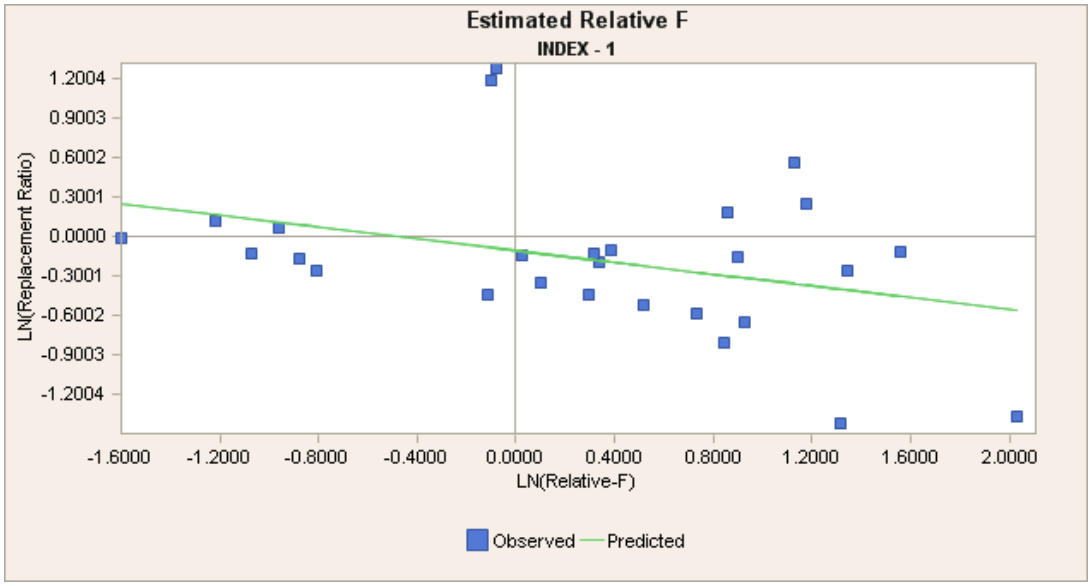

Figure P4. AIM model results for the regression of ln(relative F) against ln(replacement ratio) indicating that the stock can replace itself (relative F value where the log of the replacement ratio is equal to 0) at a relative F value of 0.616 (F_{MSY} proxy estimate).

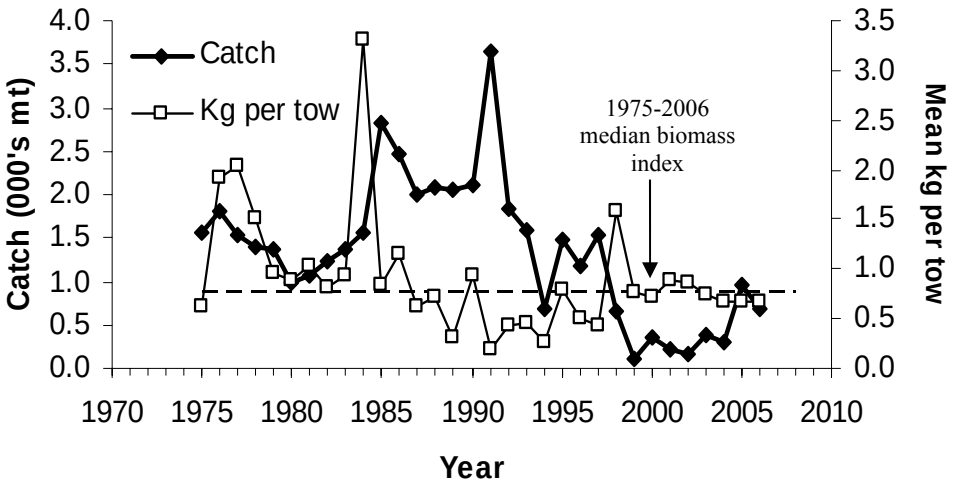

Figure P5. Trends in NEFSC fall survey relative biomass indices of GOM-GB windowpane flounder in relation to catches (mt).

7.0 Appendices

Table A.P1. Summary of GOM-GB windowpane flounder discard estimates (mt) for the large mesh (codend mesh size ≥ 5.5 in.) and small mesh (codend mesh size < 5.5 in.) groundfish bottom trawl fisheries and the scallop dredge/trawl fisheries (limited permit category), 1975-2006. Discards were hindcast for: large mesh bottom trawl during1982-1988; small mesh bottom trawl during 1975-1988; and scallop dredge during 1975-1991.

Large Mesh Bottom Trawl				
YEAR	N Observed trips	D/K	Discards (mt)	CV
1975			-	
1976			-	
1977			-	
1978			-	
1979			-	
1980			-	
1981			-	
1982			368	
1983			628	
1984			642	
1985			545	
1986			447	
1987			427	
1988			413	
1989	52	0.004	188	0.50
1990	38	0.009	600	0.36
1991	70	0.007	463	0.48
1992	60	0.002	137	0.50
1993	29	0.005	249	0.98
1994	24	0.003	118	0.41
1995	48	0.021	740	0.57
1996	23	0.008	346	0.42
1997	17	0.023	828	0.91
1998	9	0.005	192	0.42
1999	31	0.001	34	0.61
2000	93	0.003	124	0.32
2001	139	0.003	167	0.38
2002	205	0.003	126	0.22
2003	372	0.007	342	0.28
2004	425	0.006	268	0.27
2005	1,080	0.017	627	0.11
2006	516	0.019	530	0.15

Table A.P1 (cont.)

Small Mesh Groundfish Bottom Trawl

YEAR	N Observed trips	D/K	Discards (mt)	CV
1975			201	
1976			213	
1977			267	
1978			292	
1979			305	
1980			344	
1981			329	
1982			206	
1983			88	
1984			49	
1985			40	
1986			35	
1987			20	
1988			23	
1989	41	0.00027	1.9	0.72
1990	19	0.00708	59.6	0.60
1991	38	0.00016	1.4	0.75
1992	25	0.00000	0.0	
1993	9	0.00073	5.7	0.81
1994	2	0.02282	158.0	0.00
1995	32	0.00393	24.0	1.02
1996	41	0.00005	0.4	0.99
1997	4	0.00453	26.8	1.39
1998	1	0.00000	0.0	
1999	12	0.00011	1.0	0.34
2000	7	0.00797	56.8	0.61
2001	12	0.00004	0.3	0.82
2002	51	0.00091	5.6	0.73
2003	40	0.00019	1.5	0.43
2004	93	0.00065	13.4	0.46
2005	148	0.02097	261.7	0.26
2006	44	0.00623	34.0	0.52

Table A.P1 (cont.)

Scallop dredge/trawl, Limited category permits				
YEAR	N Observed trips	D/K	Discards (mt)	CV
1975			52	
1976			70	
1977			173	
1978			173	
1979			222	
1980			246	
1981			317	
1982			243	
1983			182	
1984			124	
1985			106	
1986			141	
1987			170	
1988			269	
1989			293	
1990			382	
1991			319	
1992	9	0.0034	190	0.71
1993	11	0.0030	110	0.91
1994	7	0.0051	66	0.45
1995	6	0.0035	35	0.41
1996	14	0.0032	63	0.16
1997	11	0.0120	276	0.42
1998	10	0.0044	80	0.71
1999	21	0.0005	20	0.37
2000	184	0.0007	21	0.12
2001	17	0.0008	23	0.24
2002	10	0.0009	21	0.46
2003	10	0.0004	11	0.47
2004	30	0.0004	7	0.44
2005	71	0.0004	17	0.32
2006	84	0.0010	76	0.40

Table A.P2. Number of observed trips, by fleet and quarter, included in the discards of GOM-GB windowpane flounder estimated using data from the Northeast Fisheries Observer Program, 1989-2006.

	Large mesh otter trawl					Small mesh groundfish otter trawl			Scallop dredge/otter trawl		
Year	Q1	Q2	Q3	Q4	Total	Q1and Q2	Q3 and Q4	Total	Q1and Q2	Q3 and Q4	Total
1989	3	22	20	7	52	11	30	41			0
1990	4	13	10	11	38	2	17	19			0
1991	14	12	18	26	70	1	37	38		1	1
1992	31	15	5	9	60	4	21	25	3	6	9
1993	8	10	4	7	29	2	7	9	7	4	11
1994	12	6	3	3	24	1	1	2	2	5	7
1995	22	12	6	8	48	2	30	32	1	5	6
1996	7	12		4	23	3	38	41	8	6	14
1997	10		5	2	17	4		4	6	5	11
1998	3	4	2		9	1		1	2	8	10
1999		3	14	14	31	1	11	12	4	17	21
2000	25	29	20	19	93	4	3	7	25	159	184
2001	18	30	39	52	139	6	6	12	17		17
2002	24	14	78	89	205	3	48	51		10	10
2003	105	77	102	88	372	15	25	40	3	7	10
2004	71	72	118	164	425	19	74	93	2	28	30
2005	278	259	241	302	1,080	61	87	148	10	61	71
2006	219	107	132	58	516	24	20	44	16	68	84

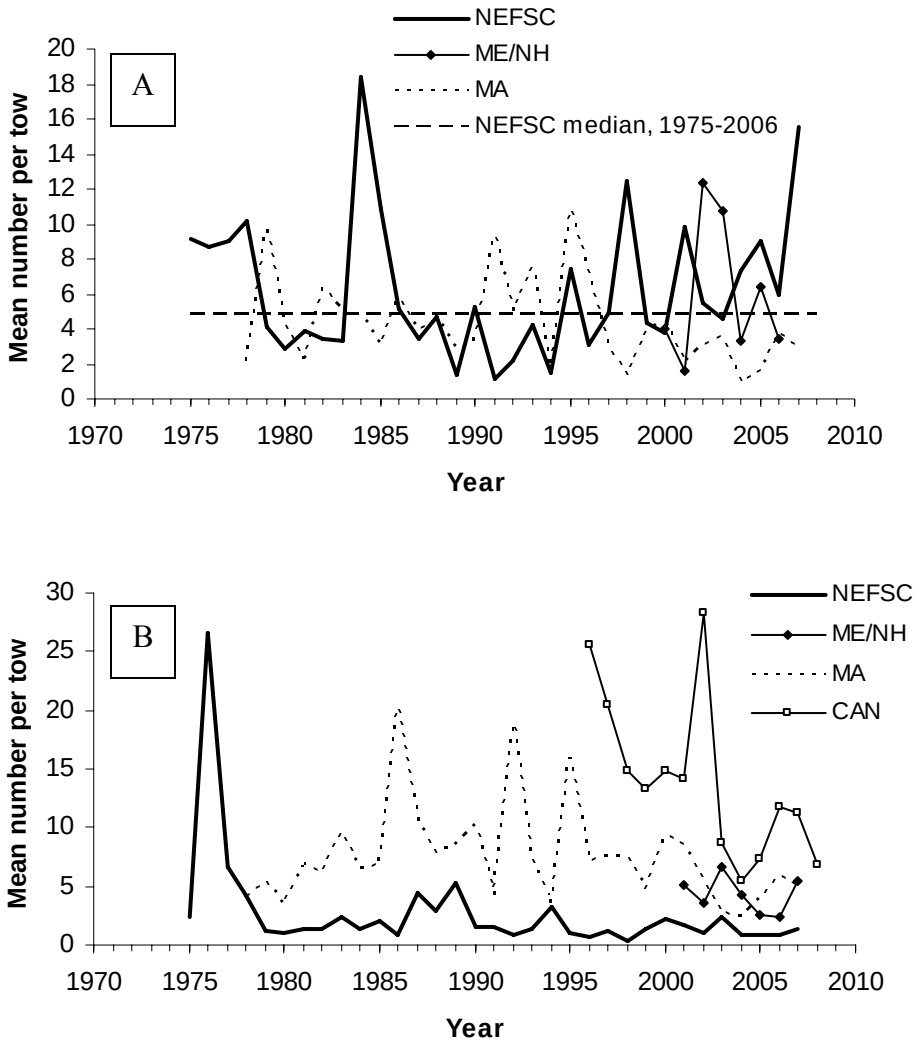

Figure A.P1. Relative abundance indices for GOM-GB windowpane flounder caught during (A) fall surveys conducted by the NEFSC, MA, and ME/NH and (B) during spring surveys conducted by the NEFSC, MA, ME/NH and Canada.